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NOTES
ON THE
STOMACH AND SECRETION,
PUBLISHED
AS AN
INAUGURAL ESSAY:
SUBMITTED TO THE EXAMINATION
OF THE
REV. J. ANDREWS, D. D. PROVOST
(PRO TEMPORE)
THE
TRUSTEES AND MEDICAL FACULTY
OF THE
UNIVERSITY OF PENNSYLVANIA,
ON THE THIRD DAY OF JUNE, 1805;
FOR
THE DEGREE
OF
DOCTOR OF MEDICINE.

BY THOMAS EWELL,
OF VIRGINIA,
HONORARY MEMBER AND ONE OF THE SECRETARIES OF THE
PHILADELPHIA MEDICAL SOCIETY.

Reason and free enquiry are the only effectual agents against error. They are
the enemies of error, and error only. JEFFERSON.

PHILADELPHIA:

PRINTED FOR THE AUTHOR, ON THE TENTH DAY OF MAY.

.....
1805.

TO JOHN WEEMS, M. D.

OF

THE DISTRICT OF COLUMBIA,

MEMBER OF THE MEDICAL SOCIETIES OF EDINBURG,
PHILADELPHIA, &c.

DEAR SIR,

IT is with peculiar pleasure I thus publicly shew a disposition to respect you, originating with a sense of your superior abilities. In doing this, I am not unconscious how little you are in need of it from such as myself. Situated in the metropolis of a flourishing republic, surrounded by a discerning people, who deal with men as they deserve....you have every thing desirable. Already have your humane acts allured the affections of many. Your disinterested exertions to encourage the study of the medic art, will long be gratefully remembered.

For several successive years you have been one of the best of my benefactors. When the darkness of ignorance debarred me from the pleasures of the pursuit of science, you interfered. You administered the stimulus to study. Where then should bounds be set to my gratitude for the source of all my intellectual enjoyments? But I am conscious this is not the place to record your virtues; they are engraven where they can never be effaced. However, I may add, the more frequent imitation of your example would facilitate the progress of science.

That you may long enjoy the rank you so deservedly hold in the profession, as well as the respect of an enlightened people, must be the wish of all friends to justice; and of none, believe me, Doctor, more ardently than your

Respectful, and affectionate

Pupil,

T. EWELL.

THE HISTORY OF THE

REIGN OF

CHARLES THE FIRST

By Sir Samuel Purchas
Knt. of the Bath
Esq. of the Inner Temple
Author of the Pilgrimes
His Majesties High Sheriffe
of the County of Middlesex
London Printed by I. Blount
at the signe of the Sunne
in the Strand 1633

TO DOCTOR JAMES CRAIK,

OF

ALEXANDRIA,

LATE SURGEON-GENERAL OF THE ARMIES OF THE U. STATES, &c.

DEAR SIR,

IN taking a view of the medical characters of this continent, no one more forcibly claims my attention than yours. Those talents which distinguished you during the struggles of the revolution, which endeared you to Washington, that great judge of the worth of men, command an unbounded respect. The philanthropy, and the skill which you have exercised, so successfully, for a long succession of years in lessening the pains of others, secure the warmest admiration. The contemplation of your excellent example is happily calculated to excite an ambition to walk in the way you have done. How great, then, must be your services to the republic, by thus leaving, for the rising generation, so brilliant and so unspotted a reputation!

As you have enjoyed, venerable Sir, many of the honours of the world, I have only to wish, that your valuable life may be rewarded by the best blessings which heaven can bestow. And I may truly add, it is one of the most anxious prayers of your

Respectful, and

Indebted Servant,

T. EWELL.

PRELIMINARY.

AMONG the numerous causes retarding the rise of medicine, an excessive love of fame appears no inconsiderable one. It has interrupted that harmony and co-operation indispensably necessary for the progress of an extensive science. It has caused a continual warfare between medical characters, unavoidably diverting their attention from its proper object. Such seems to have been, in many instances, the desire for reputation, that physicians made the strongest struggles to secure it. After opposing and condemning truths accidentally revealed by others, they would become conspicuous by the promulgation of the most extravagant hypotheses ; and thus has every age witnessed a most dishonourable scene, among men professing the first of sciences. However that fame, the delight of our forefathers' fancy, is at length fast fading away. Their glory is eclipsed, and the sun of their reputation has set for ever. To profit by their unfortunate examples, remains one of the greatest privileges of the prosecutors of the profession. As if discoveries were proportionate to the nobleness of the incentives, the rapid progress was reserved for a people influenced by the purest principles. The age of philanthropy having now advanced, useful knowledge alone has become the universal object. Disinterested philosophers have arisen and adorned the annals of medicine, with theories published only to explain. Severed from the shackles of selfishness, they have become the benefactors of mankind. The numerous band cordially united, have borne the genuine banners of science. They

have entered the recesses of nature, and revealed the secret simplicity of her operations. From their generous and great exertions, the principles of science are emerging.... destined to be the connecting bonds of millions yet unborn. These will long stand safely rooted in the hearts of nations, as plants, around which genius will ever sprout.

In daring to deviate from the beaten track, in the following pages, I was regulated by a regard for truth. The opinions were formed from facts which occasionally occurred during my studies. The brief support which they receive may be one of the many glaring errors which the more experienced reader may discover. At least this was unavoidable, as under present circumstances, I could not print on a more extensive scale. There is, however, a consolation in the fact, that should there be new truths, strong minds will discern them, although but an obscure glimmering shew the way.

It was deemed unnecessary to add more frequently the names of the authors of opinions. Those who have read with attention will readily perceive where I am indebted to others. Nor can such be surprised at the frequency of these debts. KNOWING THE IMPROVEMENTS OF MODERNS, ONE CANNOT FAIL SEEING, THAT TO BE A CORRECT ECLECTIC, IS ALMOST THE EXTENT OF OUR EXPECTATIONS.

AN
INAUGURAL ESSAY, &c.
PART I.
RELATIVE TO THE STOMACH.

“When life is interested, if we are permitted to form conjectures, it should be for the purpose of submitting them to the proof of experiment, which ought to decide.”

SENAC.

HOWEVER great we notice the inquietude of the mind, we find no such principle extended to the body. The spirit of restlessness is not more striking in the one, than the disposition to accommodate to circumstances in the other. Of all the parts displaying this disposition, no one is more remarkable than the stomach. Being most intimately connected with the whole system, the exercise of its powers produces the most obvious and salutary effects.

The illustrious Abbé Spallanzani is among the first who observed the changes produced on the menstruum of the stomach by a particular regimen. He discovered that the gastric juice taken from herbivorous animals would not dissolve muscular matter; while that procured from carnivorous animals, produced no effect on vegetable substances. The instances shewing this power of the stomach to adapt its solvent to the nature of the substance acting on it, are numerous. I will add several which lately came under my notice.

On the sudden death of horses any one may convince himself by experiment, that their gastric liquor is incapable of acting on meat. In order to ascertain if the power could be acquired, I made the following experiment. An old useless horse was confined without food about thirty-six hours; corn boiled in soup was then given him, which he readily eat. In two days this was changed for coarse meal wet with soup. The readiness with which he took this induced me to add small bits of boiled meat;

and in two weeks he eat eighteen ounces of meat mixed with meal, at once, without hesitation. The experiment was then discontinued, when the only effects noticed, were an increase of the fœcor and fluidity of the fœces. There is no doubt but that by perseverance horses might digest flesh as well as other animals. Perhaps at some future period it may be deemed expedient to habituate some of them to an animal diet. Can their strength or can their velocity be increased by such a regimen?

A good old housekeeper assured me, that she raised a lamb in her kitchen principally on animal food. By degrees it became fond of boiled meats as well as milk. It grew to the common size, but was possessed of such unusual courage that it attacked a bull of the farm, and was killed in the conflict. The gastric liquor of this omnivorous sheep dissolved flesh. In this respect it essentially differed from the rest of its kind; for, as I need scarcely mention, in no instance that I tried would their gastric liquor act on muscle, although boiled nearly to a jelly.

Cows, contrary to their habits, occasionally eat and digest animal food. A mixture in which meat has been boiled is frequently given them in Virginia, during the winter. I once saw one eating her after-birth, on the morning subsequent to her delivery; and am well assured that they frequently do it. My friend, Mr. McCall, on hearing of this informed me, that he saw one of his father's cows eat a considerable portion of bacon.

But of all stomachs that of man appears to possess this accommodating principle in the most eminent degree. For as in the Laplander with his rein-deer, it enables him to receive a support entirely from animal matter; or as in some of the tribes of Asia and Africa, with their spices, entirely from vegetables; or as in the inhabitants of Orange river, from putrid seals and fishes. The manner by which such important changes in the gastric liquor are wrought, is but little known. Are they produced by the mechanical effects of the substances, whereby the state of the secretories become altered? And if substances by their mechanical powers alter the condition of the vessels in the stomach, does it not follow that the variations of the qualities of the gastric liquor must be proportionate to the variation of substances? But this idea will be more clearly expressed in the sequel.

Independently of the dissolving powers of the gastric juice, it has many other properties claiming our attention; of these an antiseptic power is no inconsiderable one. Doctors Stevens Spallanzani, and Mr. Hunter, have proved that it not only prevents but corrects putrefaction. The following experiment affords an

example of this, as well as a new argument in favour of the vitality of the coagulating lymph when united, or partially organized, as I shall hereafter say.

A coagulum of blood was divided into two portions, and placed in two cups, the first of which contained some of the gastric juice of a hog. They were then left in a room, the temperature of which was about 80° . In two days symptoms of putrefaction were perceptible in the second, while the first remained unaltered. The gastric juice was then poured from the first into the second cup; the putrefaction was stopped in two hours, and in ten the coagulum was entirely dissolved. About this time the putrefaction of the other seemed commencing; I then poured on it a quantity of gastric juice, which soon corrected the putrefaction, and dissolved the coagulum in eight hours.

Since the discovery of this property in the gastric liquor, surgeons have applied it to gangrenous parts with good effects. It has also been used for other purposes, which I shall briefly mention. The ingenious Doctors Darwin and Dorsey, speak of it as a lithontriptic, and the experiments of the latter favour the idea. Dr. Harness applied it to old scorbutic ulcers, with advantage. Jurine, of Geneva, found that it lessened the pain and irritation of foul ulcers, when applied to them as an anodyne. The callous edges of sores have also been removed by its use, when other applications failed. Mr. Home observes, that when applied to the surface of the body, its primary effect is to increase the irritation. Knowing this, we can readily understand how it hastens the effects of opium and most other medicines, when mixed with them and applied to the body. This is an important fact, and it is astonishing that the gastric juice is not more frequently used for such purposes.

In the fall of 1803 I read before the Philadelphia Medical Society, a paper on the properties of the gastric liquor. In this I suggested the idea, that it was a peculiarly powerful stimulus to the lacteals. Since then I have instituted the following experiments:

An opening was made in the abdomen of a large dog that had fasted for two days. The contents of the jejunum were pressed aside by the fingers, and two ligatures tied around it, which included about two feet of the intestine. Between these ligatures an orifice was made, and an ounce of the gastric juice of a hog injected. This orifice was then closed, and the parts reinstated in the abdomen for three hours, when the dog was killed, and his intestines examined. The inflammation of the peritoneum was considerable, and particularly about the ligatures. On opening the

intestine I found that three-fourths of the gastric juice had been absorbed, and that a mucus had been secreted in its cavity, thicker and in a larger quantity than was natural.

In the next instance I procured equal quantities of the gastric juice of a hog, bile, and my own saliva. Each of these were injected into the smaller intestines of a dog, which had been divided into equal portions by four ligatures applied as above. The intestines were replaced in his abdomen, where they remained for three hours; the dog was then killed. I found that the inflammation was more considerable than in the former experiment; that the gastric juice was near half absorbed, the saliva about one-fourth, and the bile not in the least, but blended with considerable quantities of mucus.

I next attempted to ascertain how far the preparation of chyle depended on the gastric juice. For this purpose I saturated an ounce of this solvent with well boiled meat in a temperature of 110° . A dog that had starved for two days, was then opened, and two feet of his jejunum cleansed and secured as in the first instance; a puncture being made, this compound was injected in the gut, where it remained for three hours confined in the abdomen. The dog was then killed and examined. About one-third of the mixture was absorbed, and the mesenteric glands coming from the tied intestine contained a small quantity of chyle; there was also a small quantity in the thoracic duct, which as well as the former was more limpid than usual, being blended with the lymph of which the remaining glands were filled. These experiments inclined me to believe that good might result from the exhibition of the gastric juice in particular diseases. They also served to induce a friend of mine to make the following experiment, an account of which he gave me:

“Two puppies of the same litter were procured, and confined in a room. The first weighed two pounds, and the second two pounds five ounces. I injected in the rectum of the first, twice a day, a mixture composed of two ounces of gastric juice (procured by sponges) and three ounces of a rich soup well sweetened; at the same time five ounces of the sweetened soup were injected in the other. This troublesome experiment was discontinued in ten days, when the dogs were weighed. The first lost only two ounces and three drachms, while the other lost four ounces and two drachms. Imperfect as is this experiment, it favours the idea, that some good would result by combining the gastric juice with nutritious substances for injections, when patients require enemata for a support.”

During the convalescence from fever, when the atony of the intestines is great, and the secretion from the stomach vitiated, nothing appears so well calculated to restore the parts to health as their natural stimulus, a pure gastric liquor. Should patients refuse swallowing it, the beneficial effects might probably be derived by frequent injections. That species of diarrhœa proceeding from a torpor of the absorbents, it seems happily calculated to remove. The irritability of the stomach is occasionally so much increased, that it will retain nothing for many days. Professor Wistar, whose name I cannot mention without feeling the most lively sensations of respect and gratitude, is in the habit of relating to his class such important cases as occur in his practice. Among these he mentioned an elderly lady who laboured under a distressing vomiting for several weeks: during this time her life was entirely preserved by injections, *per anum*. It is in cases like this, I presume, important effects would be derived by mixing with nutritious substances the gastric juice of healthy animals. Children, whose susceptibility to be acted on is particularly great, seem also the most proper objects to be benefited by our remedy.

Feeling convinced of the virtues of this secretion I became anxious to meet with cases in which it could be prescribed. Notwithstanding my wishes, however, only the following occurred.

A negro boy about three years old was brought to me by his mother, who said he was affected with worms. He had a slight diarrhœa, a tumid abdomen, and daily became debilitated. A few grains of calomel were given, which purged him, but brought away no worms. I then collected a considerable quantity of gastric juice from several hogs that were killed; its disagreeable odour was entirely removed by powdered charcoal. Three injections, of about four ounces each, of this sweetened, were given him at first, and two doses, about an ounce each, were swallowed daily for ten days; on the fourth day, five worms of the *lumbrici* kind, were voided; and on the sixth three others. The strength of the boy increased with his appetite, and he was perfectly recovered in three weeks. Did the anthelmintic power proceed from the tone given the alimentary canal? Or, did the symptoms proceed from an affection of the mesenteric glands, and the recovery from their restoration? In either case the remedy seems equally well adapted, as the application of a natural stimulus to the diseased mesenteric glands, must tend to excite their natural action.

Since the above was written, I have found that Carminati, an Italian, and Jurine, of Geneva, have exhibited the gastric juice in

several cases. It was used successfully in cases of indigestion, vomiting of acid and black matter, and in intermittent fever. The approbation of such respectable authors affords an additional inducement to exhibit this secretion.

The difficulty of procuring the gastric liquor may prevent its introduction into general use; but if in a few cases it affords relief, it is entitled to a place in the *Materia Medica*. Such a preventive, however, cannot be urged against our using it in a manner and for a purpose I shall now propose.

It is well known that there are medicines (resins for example) which are soluble in the gastric juice, only when blended with gum or mucus. It is on this account, I presume, aloes will act only in the rectum, where it unites with the mucus of the gut. It must appear evident that most medicines do not act on the stomach before they are dissolved in its menstruum; nor can it be doubted that the effects of medicines must vary with their solvent. Hence, as the gastric juice is liable to the greatest changes, we frequently see the same medicines produce different effects on different persons. It is also on this account that I presume the same medicine produces different effects at different times on the same person; and that in some instances particular forms only of a medicine will operate. Doctor Rush, in speaking of clinical cases, observed, that an opium pill had sometimes checked vomiting when most other remedies had failed. And in the case of my mother, affected last fall with an incessant vomiting, I found that a watery solution, only of opium, could afford relief. In some instances it has been found that very active medicines would prove either inert, or exert some uncommon power on the system. To prevent such occurrences I imagine it is only necessary to mix the doses with a small quantity of the gastric juice of healthy carnivorous animals. This would be the more proper in dangerous cases where, at critical periods, a slight irregularity might prove destructive. The suggestion appears so plausible, that I cannot avoid wishing, that practitioners will at least ascertain if it deserves to be prosecuted.

IN the fall of 1804 I performed several experiments, which, perhaps, deserve to be mentioned. Minute details of them were drawn up, but as they are too lengthy, I will only state the results. They were instituted with a view to ascertain the effects produced by an accumulation of blood in the stomach.

By making a free incision into the abdomen of a dog, in an oblique course from the sternum to the spine of the right side, access could readily be obtained to the liver. I performed this operation on several dogs; and around the vena portarum of some, tied a ligature tightly; in others the ligature was only drawn so as partially to compress this vein, while, in a few, it was applied around one of the lobes of the liver.

In the cases where the obstruction was greatest in the liver, death shortly followed, and the viscera appeared in that state denominated, suffocated excitement, by the illustrious professor Doctor Rush, who will live for centuries in the hearts of his countrymen, for his important innovations and improvements. The blood suddenly acquired the dissolved appearance common in typhus, which is another proof that it does not depend on putrefaction.

When the passage of blood from the viscera was partially impeded, the symptoms varied considerably. There was a great sensibility and soreness of the stomach, shewn by the incessant vomiting and sighing. This was proportionate to the obstruction in the liver: and hence, Hippocrates, in his seventh prorrhetic, remarks, that this indicates the degree of danger in malignant fever. There was a dark mucilaginous matter vomited up, which was evidently secreted in the stomach. This corroborates the opinion suggested by Doctor Stewart, but demonstrated by Doctor Physick, the John Hunter of America, that the stomach in yellow fever is the source from which this matter is derived. A dysentery and cholera came on in some instances, and the evacuations were so considerable as to produce in a short time a remarkable degree of emaciation. Mr. Mathews, and Doctors Girdlestone and Saunders, have mentioned similar effects which occurred in hepatic affections, and it is probable, that in epidemics where these symptoms take place, they proceed from a similar cause.

Unless the passage of blood from the part be impeded, it is difficult to conceive how such large quantities of fluids could be secreted in so short a time.

In some instances there was a furious delirium, and in others a disposition to coma. This, together with the frequency of hepatic affections in mania, led me to conclude, that diseases of the brain might originate from the liver. As the irritability of parts is generally proportionate to the quantity of blood in them, the irritability of the stomach must be increased when the blood is accumulated in it, in consequence of hepatic obstructions. The ordinary stimuli then acting would produce convulsive action, which, being communicated to the brain by sympathy, constitutes the disease. It must, however, be observed, that the symptoms following affections of the liver, like those of the brain, are not always proportionate to the apparent injury. In the New York Medical Repository, I published an account of a lunatic, whose disease evidently arose from sympathy with the stomach. Since then my opinion has been strengthened by the concurrence of the learned Doctor Pascalis of this city.

PART II.

RELATIVE TO SECRETION.

“ False principles in medicine have slain their thousands and tens of thousands. The great evil consists in the servile adherence to one particular system.” B. RUSH.

WHEN we contemplate the animal machine, we are struck with the extreme vascularity of all its parts. This is so general and considerable, that the human body has been emphatically called a “collection of capillaries.” In these tubes or vessels, the most important operations are performed. It is in these that the blood is so wonderfully modified, as to be adapted to all the exigences of the system. The most general operation we notice, is the conversion of arterial into venous blood. No part is exempt from this remarkable process, whereby the properties of blood become so materially altered. While we keep in view the uniformity and the simplicity of the operations of nature, we will account for this phenomenon on common principles.

It is an undoubted fact, that the form and properties of most substances are variable, depending considerably on the circumstances in which they are placed. By experience and observation, we learn what changes can be produced, and what is necessary to produce them. For example: of water, we find that in a low degree of heat, the particles cease to roll on each other, and become so arranged as to constitute ice. In a higher degree, another substance, the egg is deprived of its fluidity, while the solidity of a metal is lost in the same temperature.

In accounting for these phenomena, we do not call in the agency of an intelligent *vis vite*, or uncommon principle: neither can they be referred to one of the agents separately. All agree in referring them, to the natural tendencies or affinities of the substances, exercised in consequence of the circumstances created by lessening or augmenting the heat. No objections can be urged against extending this method of philosophising the method of induction, as proposed by Lord Bacon, to the human body. Let us then mention the facts, and make the inductions as in the above instances.

But a little experience is necessary to teach us that the arterial blood, like most substances, is susceptible of the greatest changes, and that these can be varied with the circumstances in which it is placed. For example; in the arteries we see it is of a vermilion colour: but as Sir Isaac Newton long since observed, in a particular position, it will reflect the yellow rays of light. We see also, that it readily loses its fluidity in a temperature of 160° or when permitted to rest. In the last instance, the coagulating lymph unites, and becomes solid. This tendency of the lymph is also seen in the granulations of wounds, which, being covered with it, readily unite together. The coagulum formed by the union of the lymph, possesses some of the characteristics of life. These are, I presume, acquired in consequence of the union or partial organization of the lymph, effected by the attraction of cohesion. Hence such causes as destroy the aptitude of the blood to appear vital must act so as to prevent the tendency of the lymph to combination. Hence in inflamed parts, where there is a considerable quantity of blood, there must be an increased deposition of organized coagulating lymph, and consequently often a painful increase of irritability and sensibility. This, however, does not take place when the deposition is in the cellular membrane, as in schirrus tumours. But to return from this digression. When the blood is propelled to the small capillary vessels, in consequence of fibrous action (which is the only effect of it we perceive) the circumstances necessary for its continuance in the state of arterial blood no longer exist. On arriving at the commencement of the veins, it takes on the properties peculiar to it in that state of parts, and is thus converted into venous blood. Here we see the agents, the solids of the part, and the blood, as in the former instances. As the solids remain unaltered, the effects we should refer to the natural affinities of the blood in the parts, just as we do the various shapes of water, eggs, and all other substances.

If the above be correct, we are led to look upon the body as a laboratory in which the most important operations are performed. From the differences in its construction, we naturally conclude that various compounds are formed; accordingly we find that different processes go on, and that fluids different from venous, are separated from arterial blood. These are the secretions familiar to us all.

Physiologists in accounting for the secretions since the rejection of the explanation on principles of mechanical filtration, as proposed by Baron Haller, have referred them to chemical changes wrought by the actions of the secreting vessels. The only effect of the

action of a gland, that we can perceive, is to propel the blood through it; and indeed it is to me incomprehensible, how the motions of simple tubes or vessels could possibly produce changes in any fluid. I shall therefore wave the consideration of the supposition, and proceed to account for the phenomena on the simple principles suggested above.

Although we are not able to detect the particulars in which one secretory vessel differs in its structure from another, yet on the slightest attention, we can perceive a very material difference. We can readily discover that the delicate hand of nature has made an astonishing modification of even the most minute vessels. From the various structure of all the glands, the blood, when propelled in them, assumes in each, in consequence of exercising the affinities peculiar to it in that state, the necessary form and properties. Mr. Home observes, that immediately on leaving the vessels, the secretions are fluid, and acquire their consistence shortly after, as is instanced in pus. When the new properties are thus acquired, the ducts convey them to the parts for which they were formed. It is thus, I presume, by the exercise of chemical laws, regulated by the mechanism of parts, that the successive supplies of all the secretions, are created from the blood.

If this explanation be admitted, the vague conjectures of physiologists relative to secretion will be laid aside. In place of them, we will have the plain facts, that nature was accurate and wise, when she so made the solids of animals, that the fluids acquire in them, by their own tendencies, the necessary form and properties. Nor does she here demonstrate more forcibly, a delicacy and wisdom in operating, than in the structure of her master-piece, THE EYE.

Our theory has something more than simplicity to render it plausible. It will enable us to explain several phenomena which have been noticed.

The analogy of all venous blood coming from glands secreting very different fluids, can no longer remain a mystery.

The formation of an oleaginous matter like spermaceti after death, in the body, and many other secretions, are common occurrences. Fourcroy, by a particular process, was enabled to form bile from the blood of an ox, which has been erroneously supposed a proof of its being in a formed state in the blood. It must readily appear from the invariable tendencies of matter, that whether the necessary circumstances for the formation of a substance exist in the body before or after death, or elsewhere are created by art, that such a substance would be necessarily created, when the com-

ponent parts are present. Hence this leads us to expect, that from the progress of knowledge, all the secretions will, at some future day, be formed by our art.

There is a system of vessels whose office to the body seems the reverse of that of the secretories. This is the absorbent or supporting system, formed by the lymphatics and lacteals. While the one is engaged in diminishing the volume, the other is no less industrious in renovating our blood. It is through the medium of these vessels that chyle is formed from our food, sometimes even after death, and that all the secretions of our body, tumours, pus, extravasated blood, &c. are returned to the sanguiferous system. In these processes we find nature adhering to her beautiful simplicity. By a proper and similar formation of these vessels, all this variety of substances, on entering in them, assume the same appearances in consequence of their natural affinities in that state, just as they acquired other properties under different circumstances in other parts. When these new properties, the properties of lymph are thus acquired, it is conveyed to the blood-vessels, and according to the ingenious Doctor Hutchinson, the blood exerts a power in the assimilation. Being under the same circumstances, and having the same constituent parts, it must readily appear how the same form, &c. is immediately acquired on the entrance of the lymph. It is in this manner that in continued fevers, where no nourishment is taken for weeks, the large quantities of blood, I presume, are formed from the secretions, the absorption of which must be accelerated during the general increase of fibrous action. This is confirmed by the circumstance that the animals in the north during their torpor are entirely supported by the absorption of fat, a secretion, deposited in their cellular membrane.

There is a fact, familiar to most of us, that tends to prove the correctness of these opinions. This is the support which one animal receives from the secretions of another. It is true that some of these are more nutritive than others. This must proceed from a powerful attraction resisting the lesser tendency to assume the form necessary for nourishment. Although when the secretions are submitted to intense degrees of heat, different results are obtained, yet it is no proof that the primary parts are not the same. This cannot be questioned when we attend to the great power of heat to cause different combinations. We have an example in the experiments of Mr. Abernethy, who, by subjecting vegetables that grew in perfectly pure water and air to the action of fire, obtained a quantity of iron from them. The secretions having a tendency to spontaneous separation, afford a most generous support, and fat

and milk are among the most remarkable. When these are eaten, they are conveyed to the lacteals, and, after taking on the properties of chyle in them, pass on to the blood, and assume its properties. Here we have almost to demonstration the same particles in the shapes of a secretion, chyle, then blood, in which last, it originally was.

The laboratory of which we have been speaking is liable to the greatest revolutions from a variety of causes. The mechanism of every part may be deranged; the ordinary actions and processes be suspended; and new operations take place. These being deviations from health, according to the sagacious Gaubius, constitute disease.

The causes of the derangement of the animal solids, or containing parts, are innumerable; most incitants, under particular circumstances, may affect, in some manner, the yielding capillaries, so as to produce disease. In some of these affections of the solids, very uncommon combinations take place in the fluids, which are termed, "morbid secretion." The causes producing this, I presume, act entirely mechanically on the minute vessels, altering the ordinary states, and creating others peculiar to them. It is in this way, for example, I suppose that vegetable and animal substances cause a difference in the secretion of the stomach, while hepatic obstructions which cause the black vomit, &c. create a still greater difference. Also, when the morbid poisons are applied, they appear to act in a similar way, producing a capacity peculiar to them in the solids, when the neighbouring fluids enter and assume the properties peculiar to that state of parts. This leads us to reject the great Mr. Hunter's supposition, "that the animal fibre has the power to produce, by a particular action, a substance peculiar to the irritant applied;" and Mr. Moore's idea, that there is any thing like fermentation excited in the blood in such instances.

From the manner we have considered this subject, the propriety of directing our remedies for disease, to the solids, will at once be obvious. It will appear still more proper when we recollect that such is the nature of the capillary vessels, that when diseased states are produced in them, changes wrought by depletion, mercury, &c. have the effect of removing them, and leaving active the tendency to return to the healthy state.

In a few instances, where certain states of our solids occur, they can be obviated only by extirpation. We have an example in cancer, where the morbid matter is continually formed. However, it is not probable that this imperfection in our art will long continue. Will the application of syphilitic matter, by producing the state peculiar to itself, alter this cancerous condition of the vessels?

An idea of the great mutability of our solids may be formed from the following specimens, recorded by authors, of morbid secretion. M. Chaptall tells us of a man, who in a convalescence from fever, on washing his hands, found that ammonia was thrown off. Berthollet assures us, that he had known the phosphoric acid to be perspired. Doctor Rush, in an epidemic, saw a woman's milk of a green colour. The carbonate of lime is said to be frequently secreted in parts affected with arthritis. In such affections Doctor Walsten has proved that pure lithat of soda is sometimes formed. Sir J. Pringle obtained a caseous looking matter from the intestines which he supposed was secreted in dysentery. Doctor Maclurg found an insipid fluid in the gall bladder. Doctor Weems, who is an accurate observer of nature, saw a matter analogous to green vitriol, in solution vomited up in several cases, which he supposed was secreted in the stomach. And in all the stinking sores of our bodies, we have remarkable instances of morbid secretion. Perhaps at some future period, when the characteristics of each morbid affection are correctly known, they may be designated by the substances newly formed. A nomenclature founded on such principles, would require ages of minute attention for its perfection. It would require a refinement in our observations, to ascertain precisely the precursors, concomitants, and characteristics of a cancerous, urinary, or syphilitic state of parts on the surface of the body.

When the natural capacity or condition of our solids is deranged, it is not always that compounds foreign to the body are formed in them. From the influence of sympathy or consent of parts, the secretions of other glands are occasionally created in them. Such instances Doctor Rush has beautifully termed, "translation of action." It will be of some consequence to be aware of the fact, that there must be a translation of state as well as action in such cases. When the state is created, the blood, on entrance, will as necessarily assume the properties peculiar to it in that condition, in one part of the body as well as in another.

There are many remarkable instances on record of one part's performing the function of another. Among these we frequently hear of women's menstruating by the stomach. Doctor Senter published an account of a girl who voided urine by the stomach for a considerable time. Doctor Heberden met with one who made no urine for two years. In this time her perspiration was profuse, and of a urinous smell. After death she was dissected, and no vestige whatever of her kidneys remained. In the late edition of Haller's Physiology, mention in a note is made of a woman who voided no urine for three weeks. Her perspiration was so

profuse and disagreeably urinous, that not even her husband would approach her. After death one kidney was found completely suppurated, and the other reduced to half the usual size. An account is also given of a man who secreted milk in his groin. The illustrious philosopher and president of the union, Mr. Jefferson, attributes the peculiar odour of the negro, to the lessened action of the kidneys, and consequently increased perspiration. This suggestion is strengthened by the fact, that they are not subject to calculous affections, which, as Dr. Rush observes, proceed from the kidneys.

The consideration of the above facts has led me to apply the principle to the explanation of a phenomenon which frequently occurs in warm countries. This is the bilious yellow tinge, characterizing the malignant or yellow fever. There is a considerable difference in the manner of accounting for this symptom by most authors. Some have referred it to a putrefaction of the blood; while others suppose a different kind of modification to take place in it or in the serum. The baron Humboldt informed Dr. Rush, that it proceeded from an incipient combustion, which he inferred from the yellowness preceding the burning of paper. But these conjectures cannot be admitted, as it is an undoubted fact, supported by the most respectable authorities, that the colouring matter is common bile.

The gentlemen, in accounting for the diffusion of bile over the system, which they all suppose secreted in the liver, have not coincided in opinion. Some have attributed it to regurgitation, others to absorption from the liver, or from the intestines; while a few refer it to a retrograde motion of the absorbents. But granting that the bile is formed in the liver, it does not appear that the absorbents are the medium through which it is conveyed to other parts. The most powerful stimulants to the lymphatics tend to lessen and remove this yellowness. We have a case related by Jackson, where the yellowness was suddenly removed in consequence of applying a large blister to the hepatic region. This affords an argument in favour of the opinion advanced elsewhere, that such is the structure of the lymphatics, from the sameness of the constituent parts of the secretions, they all assume in them the properties of lymph.

Independently of this, from our knowledge of the terminations of the absorbents, it must appear, that were they to introduce the bile, it would be conspicuous in one part as soon as in another. This is not the case, as in most of the works on malignant fever, mention is made of the partial yellow appearances, which precede

the general. The feet became first tinged in the cases attended to by M^cClean, whilst Doctors Blane and Rush found it first about the neck, breasts, shoulders, &c. Again; the yellowness comes on sometimes suddenly. Now the liver, however industrious it be, could not secrete such large quantities of bile as in a short time often deluges the whole system. But in such cases the liver has generally been incapable of secreting bile. It has been in most cases either enlarged or deranged in structure and secretion. In confirmation of this, we must refer to the dissections in the works of the illustrious authors, Pringle, Physick, Poissonier, and many other accurate observers.

After weighing the above facts repeatedly in my mind, I have no hesitation in observing, that the bile colouring the body in malignant fever is formed in parts remote from the liver. This opinion, however novel it may appear, is supported by several concurring circumstances.

When the action of the blood-vessels is increased to a violent degree, and the liver in consequence of its venous structure and particular confined situation becomes affected, the passage of blood through it must be impeded. The blood must then accumulate in the viscera, and create the engorgement noticed first by the French, and since by Doctor Clarke and others; be abstracted from the surface of the body, and cause the black vomit, dysentery, cholera morbus, &c. In the diseased state of the liver, and debility on the surface of the body, the vessels of the latter acquire the biliary state, and I presume, the blood, on entering, is converted into bile in the parts. This is corroborated by the fact, that there is a considerable connection between the liver and skin, even when the vessels of the latter retain their usual vigour. We have an example of this in the gutta rosea, to which drunkards affected with chronic hepatitis are so liable, (see Zoonomia). We should be aware, not only of the natural consent of parts, of its increase, in consequence of the abstraction of blood from the surface, but also of the connection between the stomach and skin. For on the commencement of the disease, the bile is, no doubt, secreted in unusual quantities, and conveyed to the stomach and intestines. Here it may produce the state in which bile is formed in the vessels, and communicate it to the surface. A fact related by the great medical historian, Doctor Cullen, strengthens this idea. Shortly after a patient eat a quantity of putrid meat, large purple spots appeared on the skin. An emetic, the doctor observes, caused the evacuation of the contents of the stomach, and the discolouration of the skin immediately disappeared. It should also be recollected

that the arteries generally correspond in state to those of the *primæ viæ*. For example, in gastritis, we have a contracted radial artery, while in inflammation of the colon it is much larger.

It appears no less evident that the bile, that has been proven to be the colouring matter in jaundice, is not formed in the liver. Many authors have observed, that the yellowness, in some cases, was only partial in the commencement. Morgagni frequently mentions these partial bilious tinges; and Doctor Stark relates the case of one who had this symptom first about the pit of the stomach. Mr. Underwood observes, in a note annexed to his treatise on the diseases of children, that pregnant mothers dying of jaundice had not their foetus' in the least coloured with bile, as shewn, by frequent dissections. Moreover, dissections have shewn that in most icteric patients the liver must have been incapable of secreting bile. Its morbid condition is also shewn by colic, and other intestinal affections, which Van Swieten, Hoffman, and other old writers have observed to precede icterus. That the surface of the body is the part in which the bile is formed, appears probable from the itching of the skin observed by Doctors Jackson, Stark, and Rush.

There is a case related by Pringle, tending to prove that bile may be formed in parts remote from the liver. A poor soldier had, for several weeks, a large tumour in his right side, and could not lay extended. He was distressed by an incessant inclination to vomit, with an uncommon pain and sickness at stomach. Two days before his death Sir John observes, that he became suddenly suffused with bile. After death the abdomen was opened, and to the surprise of the spectators, the whole of the liver was found completely schirrous and purulent. M. Beaumé also gives an account of a similar case. A child was suddenly affected with jaundice, and died. On dissection it was observed, that the whole interior part of the liver had suppurated.

That the biliary state said to take place on the surface of the body is not more foreign to the nature of the part than others which have been noticed, will readily appear from the facts formerly adduced, as well as the following. How far these depend on affections of particular viscera, and the sympathy between them and the surface, cannot now be determined.

The yellowness is said by many authors to differ in degree. Although this may depend much on the quantity, yet no doubt the quality of the bile has considerable influence. Hippocrates, in his second book on the epidemic of Cranton, observes, that biles and eruptions on the skin were frequent; and were attended

with great heat and itching. Pustules also arose analogous to burns, and were affected with a similar sensation. Goodwin, in his historical account, notices a species of the plague, attended with an eruption, like the measles, all over the body. In two or three days they vesicated, dried away about the fifth, when death shortly followed. Sydenham, in his "*Schedula Monitoria*," enumerates a miliary eruption, as one of the symptoms of a favourable tendency. Doctor Russel, in his history of the epidemic of Aleppo, remarks, that the petechiæ were common, and of different colours. The variegated colours were a pale faint blue and dark red, being at different times more or less obscure. A marbled appearance of the skin was also visible in different parts; and such was the violence of the disease, that these colours vanished and returned at short intervals. Doctor Lind noticed, that in the East Indies a great itching of the legs frequently took place. Doctor Home, in his account of the yellow fever of Jamaica, mentions, that pimples were common about the pit of the stomach. Doctor Barton informed his class, that they were common over the whole body during the epidemic of '97 in Philadelphia. Doctor Rush observes, that in '94, falling off of the hairs, peeling off and great insensibility of the skin took place in some instances. The Doctor also observed, in other cases, a painful increase of sensibility, eruptions, roughness, and great itching of the skin. He met with some patients where the redness of the surface predominated, so as to produce the appearance of inflammation. In one instance the perspiration was so much altered, that it turned the sheets of a yellow colour for several weeks. Ulcers of a most alarming nature and destructive tendency, frequently appear during these violent fevers. I will pass over the buboes, carbuncles, &c. which have been frequently noticed. In Clifton's translation of Thucydides' Treatise on the Plague, ulcers on the toes, fingers, privates, &c. are said to have occurred. Doctor Chisholm met with cases attended with ulceration of the scrotum at Boulam, as well as apthæ of a small white kind on the skin. My friend, Mr. J. E. Cooke, informed me, that in the late epidemic of Loudoun, eruptions, ulcers, &c. frequently appeared in various parts of the body. But of all the symptoms indicating derangement on the surface of the body in malignant fever, none are so remarkable as that recorded by Moseley, McClean, and most West India writers. This is the exudation of dissolved blood from almost every pore of the body. These cutaneous hemorrhagies are attended with such an insupportable stench, that according to authors, few can approach the patients.

By the theories advanced, we are enabled to account for several phenomena which frequently occur. The yellowness, as has been observed, appears sometimes about the feet; being remote from the heart, their debility must be greater than parts more nearly situated. From the venous structure of the liver, it is inferred, that this to a certain extent favours the biliary state and action. To the debility and greater consent of parts the primary appearance of bile about the neck, breasts, &c. must be owing. The yellow colour produced by the venom of serpents is also said to proceed from bile, by some authors. This is probable from the powerfully stimulating nature of the poison, which, producing debility first at the parts bitten, favours the formation of bile about the wound, and gradually over the whole system. May not the yellowness following contusions originate in the same way?

After death from malignant fever, the yellowness suddenly appears over the body in many instances. My friend, Mr. Harts-horne, has frequently noticed this, and assured me that it proceeded from bile which he, with others, supposed to transude after death. But I cannot adopt the opinion, however disposed to value the suggestions of such excellent and attentive students of nature. Independently of the observations delivered relative to the liver, above, there is no probability, that bile could transude through the body so rapidly. Since we see it retained for weeks in the gall bladder in the anatomical room. That state of solids necessary for the blood to take on the appearance of bile, may be created in the body just before death, or some time after. The blood on entrance would assume the properties peculiar to it in that state, just as it does when the parts are adapted for the formation of spermaceti or any other animal production that has been formed after death.

It has been observed, that the state of solids must be altered, and a new one created, before new substances are formed in them. Also, that in the violent cases of malignant fever, a morbid state of the small vessels towards the surface, adapted commonly for the formation of bile, was produced. To remove such dangerous states or capacities in the vessels, the most powerful remedies are requisite. Before the act of restoration to a healthy state can take place, an universal revolution must be wrought. With various views and success depletion, mercury, blistering, and the most powerful means have been used. Our view of this disease leads us to propose an additional method. This is a large air-pump, capable of receiving the body and extremities at once. By using this machine the pressure of the atmospheric air on the body might be so lessened as to produce the greatest effects. Might not

the evacuation of a small quantity of blood, drawn through the pores of the body by this instrument, supersede the necessity of copious phlebotomy? But in other respects the apparatus appears happily calculated to relieve. A determination of blood to the surface could be created with it, so as to cause an increase of sensibility. From the increase of sensibility on the skin, the cold so highly extolled by Jackson, and most of the incitantia, might be applied to the body with still greater revolutionary power. With this machine the tendencies to diseased states on the surface, could not only be prevented, but the engorgement of the viscera, producing black vomit, cholera, &c. could be removed. During the reign of the destructive epidemics which often desolate the warm countries, such a contrivance might be of incalculable utility. It could be applied by the people at pleasure, when medical aid was not at hand.

In hepatic affections characterized by mania icterus, cholera, diarrhœa, or any disease of the abdominal viscera, such an apparatus probably could be applied with the happiest effects. BUT EXPERIENCE ALONE CAN ENABLE US TO CALCULATE WITH CERTAINTY ON THE GENERAL GOOD THAT MAY RESULT FROM ITS GENERAL USE.

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